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DECLARATION

I, Minjung Kwak, a Korean citizen of 150-037, 146-10, Youngdeongpo-dong 7, Youngdeongpo-gu, Seoul, Korea, do hereby solemnly and sincerely declare as follows:

1. That I am well acquainted with the English and Korean languages.

2. That the following is a correct translation into English of the accompanying certified copy of a Korean Patent Application No. 2002-54544, and I make the solemn declaration conscientiously believing the same to be true.

Minjung Kwak
July 26, 2005
Seoul, Korea

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KOREAN INTELLECTUAL PROPERTY OFFICE

This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office.

Application Number: Patent Application No. 2002-54544

Date of Application: September 10, 2002

Applicant(s): Samsung Electronics Co., Ltd.

Dated on September 23, 2002

COMMISSIONER

[DOCUMENT] Application for Patent

[RIGHT] Patent

[TO] The commissioner

[SUBMISSION DATE] September 10, 2002

[TITLE OF THE INVENTION-KOREAN] 광촉매 필터가 구비된 습식 전자 사진 방식 프린터

[TITLE OF THE INVENTION-ENGLISH] Wet-type electro photographic printer with a photocatalystic filter

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[EXAMINATION REQUEST] YES

[PURPOSE] I, hereby, submit the present application for the Patent and request the examination of the present invention under the Article 42 and the Article 60 of the Patent Law.

Attorney Hong-sik JEONG (seal)

[Official Fee]

[Basic fee]	16	pages	₩29,000
[Additional fee]	0	pages	₩0
[Claiming Priority Right]	0	case	₩0
[Filing Request For Examination]	6	claims	₩301,000
[Total]			₩330,000

[Documents] 1. One copy of Abstract, Specification (& drawings)

[ABSTRACT OF THE DISCLOSURE]

[Abstract]

Disclosed is a wet-type electrophotographic printer having a photocatalystic filter. The wet-type electrophotographic printer includes a discharge passage through which air inside a printer body is discharged out, at least one discharge fan positioned inside the discharge passage, for guiding the air inside the body, and a photocatalystic filter positioned inside the discharge passage, including a photocatalystic body coated with a photocatalyst, a plasma electrode and a plasma generator, the photocatalystic filter for filtering and deodorizing the air inside the printer body. Accordingly, bad smell and air pollution from the evaporation of the liquid carrier can be solved, and a wet-type electrophotographic printer with excellent printing quality is provided.

[The main figure]

FIG. 2

[Search term]

photocatalystic, wet-type electrophotographic printer, plasma

[SPECIFICATION]

[The title of the invention]

Wet-type electrophotographic printer with a photocatalystic filter

[The brief description of the drawings]

FIG. 1 is a schematic view showing the structure of a conventional wet-type electrohpotographic printer;

FIG. 2 is a schematic view showing a wet-type electrophotographic printer having a photocatalystic filter according to the present invention; and

FIG. 3 is a schematic view illustrating the photocatalystic filter of the wet-type electrophotographic printer of FIG. 2.

Description of the reference numerals in the drawings

10: photocatalystic filter	11: photocatalystic body
12: plasma electrode	13: plasma generator
20: fan	30: discharge passage
40: fusing roller	50a~50d: organic photoreceptors
51a~51d: developing roller	60a~60d: laser scanning unit
70: intermediate transfer belt	80: printer body

[Detailed description of the invention]

[Object of the invention]

[The field of the invention and the related art]

The present invention relates to a wet-type electrophotographic printer, and more particularly, to a wet-type electrophotographic printer being provided with a photocatalystic filter that uses a plasma for completely decomposing carrier vapor of high concentration through oxidation, thus capable of filtering and deodorizing dirt-laden air.

Generally, an electrophotographic printer is categorized according to the developing method into a dry type that uses a power toner, and a wet-type that uses a composition of carrier liquid such as norpar and a toner. Both the dry type and wet type are used in the printing process in which an electrostatic latent image is formed on a photoreceptor medium such as a

photoreceptor drum, feeding the toner onto the electrostatic latent image to thereby developing it into visible image, and printing the developed image onto a printing paper by passing the paper between a transfer medium that is rotated in contact with the photoreceptor body.

While the dry type electrophotographic printer has some disadvantages such as harmful toner powders, the wet-type electrophotographic printer generates no harmful toner powders and provides excellent printing quality. Accordingly, the wet-type electrophotographic printer is in demand.

FIG. 1 is a schematic view showing the structure of a conventional wet-type electrohpotograhic printer. As shown, the wet-type electrophotographic printer includes organic photoreceptors 50a-50d, developing rollers 51a-51d, an intermediate transfer belt 70, a fusing roller 40, and laser scanning units 60a-60d.

The carrier liquid of the wet-type electrophotographic printer consists of a pigment, a binder resin and a charge detector dispersed therein. For developing an image on the printing medium such as a paper in the wet-type electrophotographic printer, firstly, an electrostatic latent image is formed on the organic photoreceptors 50a-50d by the laser beams emitted from the laser scanning units 60a-60d. Then the carrier liquid is attached to the electrostatic latent image of the organic photoreceptors 50a-50d by the developing rollers 51a-51d. After that, the developed image is transferred to the printing medium, and as the printing medium and the image thereon are passed through the heated fusing roller 40, the carrier liquid evaporates into vapor. Mainly, there is a hydrocarbon mixture in the carrier liquid and the vapor include, which is one of volatile organic compounds (VOCs) such as benzene, acetylene, gasoline, toluene, ethylene, phenol, methanol, butanol, acetone, methylethyl ketone, and acetic acid. Through a photochemical reaction with the nitrogen oxide, the VOCs generate photochemical oxide, causing photochemical smog. The VOCs are poisonous chemical substances that pollute the air and incite cancer, and precursor of the photochemical oxide.

Because of the bad smell of the carrier vapor and environmental pollution, the use of wet-type electrophotographic printer has been in check despite the advantages over the dry-type electrophotographic printer.

Particularly, the air purifying machines that use the conventional photocatalyst require UV lamp for photocatalystic activity and subsequent decomposition of the organic substance. However, the photocatalystic activity by the UV lamp, with a considerably slow response and activation, was not enough to decompose the organic substance such as the one in the wet-type electrophotographic printer which has been accumulated to a high concentration from the beginning of the printing.

[Technical object of the invention]

Accordingly, it is an object of the present invention to provide a wet-type electrophotographic printer having a photocatalystic filter using a plasma, which is capable of decomposing volatile organic substance contained in high concentration in the vapor generated from the evaporation of the liquid carrier and subsequently resolving environmental problems and achieving effective deodorization.

[Construction and operation of the invention]

The above object is accomplished by a wet-type electrophotographic printer having a photocatalystic filter according to the present invention, including a discharge passage through which air inside a printer body is discharged out, at least one discharge fan positioned inside the discharge passage, for guiding the air inside the body, and a photocatalystic filter positioned inside the discharge passage, comprising a photocatalystic body coated with a photocatalyst, a plasma electrode and a plasma generator, the photocatalystic filter for filtering and deodorizing the air inside the printer body.

The photocatalyst includes at least one selected from the group of TiO_2 (titanium dioxide), SiO_2 and ZnO (zinc oxide). The photocatalyst is TiO_2 (titanium dioxide).

The photocatalystic body is a honey-comb monolith substrate coated with either a ceramic or a metal.

The photocatalystic body comprises at least one selected from γ-Al_2O_3, ZrO_2, SiO_2, SiO_2-Al_2O_3.

The photocatalystic filter is provided with respective poles of the plasma electrode in front and back sides of the photocatalystic body, and the plasma generator is connected to the poles of the plasma electrode.

Hereinafter, the present invention will be described in detail with reference to the accompanying drawings with an example of the wet-type electrohpotographic printer having a photocatalystic filter.

Referring to FIG. 2, a wet-type electrohpotographic printer according to one preferred embodiment of the present invention includes organic photoreceptors 50a-50d, developing rollers 51a-51d, an intermediate transfer belt 70, a fusing roller 40, and laser scanning units 60a-60d, like the conventional wet-type electrophotograhpic printer, and further includes a discharge passage 30 provided near the fusing roller 40 to guide the air inside the body 80 toward a predetermined direction, a photocatalystic filter 10 disposed inside the discharge passage 30 and a fan 20.

As for the organic photoreceptors 50a-50d, the developing rollers 51a-51d, the intermediate transfer belt 70, the laser scanning units 60a-60, and fusing roller 40, generally-known ones may be used.

An air inlet of the discharge passage 30 is provided in the proximity to the fusing roller 40, and guides the air inside the body 80 in a predetermined direction, from the fusing roller 40 to the outside of the body 80. The direction of externally discharging the inside air through the discharge passage 30 may vary depending on the components being employed, and it may be upper, lower, left, or left side of the fusing roller 40.

Referring to FIG. 3, the photocatalystic filter 10 includes a plasma electrode 12, a plasma generator 13 and a photocatalystic body 11 coated with the photocatalyst agent. Poles of the plasma electrode 12 are disposed at both opposite sides, i.e., in front and back of the photocatalystic body 11. Due to a considerably wide voltage gap between both poles of the plasma electrode 12 at the front and back of the photocatalystic body 11, plasma is generated and the generated plasma is involved in the reaction.

The plasma generator 13 is connected to both poles of the plasma electrode 12.

The photocatalyst for coating on the photocatalystic body 11 includes at least one selected from the group of TiO_2 (titanium dioxide), SiO_2 and ZnO (zinc oxide). Most preferably, but not limitedly, TiO_2 is used for the photocatalyst.

With the TiO_2 as the photocatalyst, the chemical reaction in filtering and deodorization of the carrier vapor can be expressed by,

[Reaction formula 1]

$$TiO_2 \xrightarrow{hv} TiO_2(h^+) + e^-$$

First, as the plasma generated from the plasma electrode 12 is irradiated to the photocatalystic body 11 coated with TiO_2, stimulated electrons (e^-) and holes (h^+) are formed by the reaction of TiO_2 as in the formula 1.

[Reaction formula 2]

$$e^- + O_2 \rightarrow \cdot\ O_2^-$$

$$\cdot\ O_2^- + H^+ \leftrightarrow \cdot\ HO_2^-$$

The formula 2 represents the reaction in which the free electrons (e^-) that are generated from the reaction 1 form hydrogen peroxide through the reaction with ambient oxygen.

[Reaction formula 3]

$$h^+ + H_2O \rightarrow \cdot\ OH + H^+$$

The formula 3 represents the reaction in which the holes (h^+) generated by the reaction 1 form hydroxyl group through a reaction with water.

The hydrogen peroxide, or hydroxyl group formed by the free electrons (e^-) and holes (h^+) contacts the hydrocarbon compound of the carrier vapor passing through the photocatalystic filter 10, decomposing the hydrocarbon compound into carbon dioxide and water and thereby removing toxic property and smell of the hydrocarbon compound.

As for the source of energy supplied to the photocatalyst such as TiO_2 (titanium dioxide), ultraviolet light can be used. Accordingly, it is possible to provide to the photocatalystic a ultraviolet lamp in place of the plasma electrode 12 and plasma generator 13. However, it is more preferable, but not limited, to use the plasma to obtain more active photocatalystic reaction of the titanium dioxide, because the wavelength of the plasma is shorter than that of the ultraviolet light approximately by 290nm – 340nm to 180nm – 430nm, while the intensity of the plasma wavelength is stronger than that of the ultraviolet light intensity by, maximum, 120000 a.u.t. to 15000 a.u.t. Also the optimum wavelength for the activation of the titanium dioxide as a photocatalyst hovers around 340nm. Furthermore, since the photocatalystic reaction by the plasma has higher responsivity and shorter activation time, the photocatalystic filter 10 having the plasma electrode 12 and the plasma generator 13 is more preferred in filtering and deodorizing the carrier vapor of high concentration fast and in great amount.

As for the plasma electrode 12 and the plasma generator 13, generally-known products can be used. In this embodiment, a non-thermal plasma system is employed for the plasma electrode

12 and the plasma generator 13. The plasma electrode 12 and the plasma generator 13 in such system requires considerably high pressure for the plasma generation.

Since there is high pressure around the plasma electrode 12 and the plasma generator 13, oxygen in the internal air of the body 80 generates ozone by the influence of high pressure around the plasma electrode 12 and the plasma generator 13. Ozone is a component having a strong oxidation property, and generates ozonide when added with unsaturated hydrocarbon. More specifically, the ozonide is a compound formed by the addition of ozone to the double and triple bond of an unsaturated organic compound. With the addition of water, the bond between carbons is severed and the ozonide becomes carbonyl group, generating ketone and aldehyde. In other words, ozone generated around the plasma electrode 12 and the plasma generator 13 is involved in the decomposing of the hydrocarbon compound, which is the carrier vapor. Since the wet-type electrophotographic printer having the photocatalystic filter according to the present invention is capable of decomposing the volatile organic compound with the photocatalystic reaction and also with the ozone generated around the plasma electrode 12 and the plasma generator 13, decomposition of volatile organic compound becomes more effective.

Any of the ceramic or metal may be used as the photocatalystic body 11. Or, one selected from γ-Al_2O_3, ZrO_2, SiO_2, SiO_2-Al_2O_3 may be used as the photocatalystic body 11. The photocatalystic body 11 may be formed as a honey-comb monolith substrate of a lattice pattern. Wider surface area can be ensured as the honey-comb monolith substrate is more densely perforated, and more carrier vapor can be absorbed and thus decomposed by the photocatalystic reaction. Accordingly, it is preferable to use more densely perforated honey-comb monolith substrate as the photocatalystic body 11. Furthermore, it is preferable that the photocatalystic body 11 has the same radius as the inner radius of the discharge passage 30. The photocatalystic body 11 may be formed such that it can have circular or square section. In other words, the photocatalystic body 11 may be formed as a cylinder or rectangular solid with no specific limit for the height thereof.

In addition to the plasma electrode 12, the plasma generator 13 and the photocatalystic body 11 coated with the photocatalyst, an absorbent of carbon filter may also be provided to the photocatalystic filter 10.

In order to induce air stream in a predetermined direction, there is the fan 20 provided inside of the discharge passage 30. The fan 20 may be disposed between the inlet portion of the discharge passage 30 and the photocatalystic filter 10, or between the photocatalystic filter 10 and the outlet portion of the discharge passage 30. More than 2, i.e., plural fans 20 may be provided.

In the wet-type electrophotographic printer, while a printing medium such as a paper sheet passes through the high temperature fusing roller 40, the liquid carrier evaporates, generating harmful vapors of hydrocarbon compound having foul smell and toxic property. However, with a photocatalystic filter 10 according to the present invention, the hydrocarbon compound of the vapor entering the discharge passage 30 is decomposed into water and carbon dioxide by the photocatalystic reaction as the vapor passes through the photocatalystic filter 10, and discharged out through the outlet portion of the discharge passage 30. As a result, the wet-type electrophotographic printer exhausting non-toxic and odorless air can be provided.

[Effect of the invention]

As described above, in the wet-type electrophotographic printer having a photocatalystic filter according to the present invention, a harmful volatile organic compound generated in the printer body during the evaporation of the carrier is decomposed into carbon dioxide and water when it passes the photocatalystic filter. As a result, an environment-friendly and odorless wet-type electrophotographic printer with high printing quality can be provided.

Although a few preferred embodiments of the present invention has been described, it will be understood by those skilled in the art that the present invention should not be limited to the described preferred embodiments, but various changes and modifications can be made within the spirit and scope of the present invention as defined by the appended claims.

[What is claimed is]

1. A wet-type electrophotographic printer having a photocatalystic filter, comprising:

a discharge passage through which air inside a printer body is discharged out;

at least one discharge fan positioned inside the discharge passage, for guiding the air inside the body; and

a photocatalystic filter positioned inside the discharge passage, comprising a photocatalystic body coated with a photocatalyst, a plasma electrode and a plasma generator, the photocatalystic filter for filtering and deodorizing the air inside the printer body.

2. The wet-type electrophotographic printer of claim 1, wherein the photocatalyst comprises at least one selected from the group of TiO_2 (titanium dioxide), SiO_2 and ZnO (zinc oxide).

3. The wet-type electrophotographic printer of claim 1, wherein the photocatalyst is TiO_2 (titanium dioxide).

4. The wet-type electrophotographic printer of claim 1, wherein the photocatalystic body is a honey-comb monolith substrate coated with either a ceramic or a metal.

5. The wet-type electrophotographic printer of claim 1, wherein the photocatalystic body comprises at least one selected from γ-Al_2O_3, ZrO_2, SiO_2, SiO_2-Al_2O_3.

6. The wet-type electrophotographic printer of claim 1, wherein the photocatalystic filter is provided with respective poles of the plasma electrode in front and back sides of the photocatalystic body coated with the photocatalyst, and the plasma generator is connected to

the poles of the plasma electrode.